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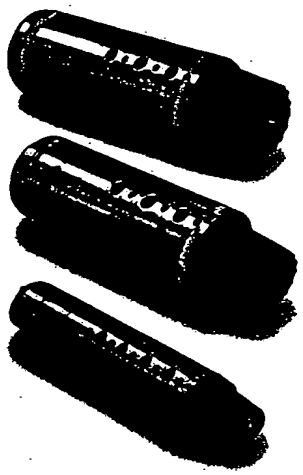

Magnetic Steering Tool Brings Drillers A "Bit" Closer

In some ways, steering a drill bit is like guiding a missile. A directional error at launch will grow quickly if the missile has far to travel. So it goes with drilling wells: the effect of an error expands with the distance drilled.

The problem is that few, if any, of the steering and guidance mechanisms on the North American market today were designed to reduce the margin of error sufficiently for the most demanding drilling applications.

One such application is steam-assisted gravity drainage wells. Typically, SAGD holes are parallel, horizontal wells that track each other exactly. During drilling, the margin of error must be tightly controlled, since the well's ability to produce heavy oil later depends on being able to maintain a short, but constant distance between the two wells: one, a steam injector, the other, an oil producer.

Existing steering systems, such as MWD (measurement-while-drilling), do not do the trick, engineers say, because they do not fully resolve the margin of error, something engineers working on SAGD projects know from experience.

"The margins of error (with MWD) are small, but very significant when you're trying to drill wells that are only four or five metres apart," says Doug Hollies, an engineer with the thermal recovery unit of EnCana Corporation. In May 2001, Hollies worked on what was then PanCanadian Petroleum's SAGD project at Senlac, Saskatchewan.

For example, he says, a 1 000-metre horizontal well could lose six or seven metres during drilling due to instrumentation error alone. A directional driller could find himself off-target by a wide margin, at the end of the day. "You can't use regular MWD telemetry to (drill) the parallel well," Hollies adds.

Because MWD telemetry has not always been enough, some companies are turning to another system to guide the drilling process. As its name implies, the Rotating-Magnet Ranging System (RMR) developed by Vector Magnetics LLC uses rotating magnets to guide the bit during drilling.

With RMR, a sub containing the magnets is installed directly behind the drill bit. As the bit turns, the magnets turn at the same rate, creating a time-varying magnetic field, detectable by Vector's magnetometer or sensor, which sits in a nearby well.

In the SAGD context, the magnets are run in the upper (steam injector) well, attached to the bit as it drills horizontally, while the sensor sits in the previously-drilled and cased horizontal leg of the oil producer, below. The sensor in the lower well is positioned just ahead of the bit drilling the injector, above.

The path of the producer thus guides the drilling of the steam injector. The drilling bit and magnets gradually approach, then pass the sensor below. Meanwhile, the sensor is continuously gathering information on the magnets' position in the injector, relative to the sensor.

"You gather quite a bit of data over several minutes while you're drilling," says Rahn Pitzer, operations manager for Vector Magnetics of Ithaca, New York. "That gives you a very accurate location. Then you move the tool ahead of the bit, and drill past it again, to get another location. Then you move ahead again. You do this for 700 or 800 metres, all the way down the horizontal section.

"We get a very precise fix on where it is, relative to the first well," Pitzer adds. "The driller uses that information to correct his position, to be typically directly above the lower SAGD well.

"All we do is give him a relative fix, like 'you're five metres above and two metres to the left.' Then the driller says, 'I need to get back over this thing, to turn a little bit to the

right.' We're giving him discrete, relative location information, typically about every 10 metres. He uses conventional drilling practices to correct his path."

According to engineers who've used it, the RMR system eliminates most of the directional error involved in standard MWD drilling, and results in much better accuracy in reaching the target.

"You can talk to virtually any company that drills SAGD, and they will tell you that this is a desirable thing," says Hollies. He says RMR technology eliminates the accumulated error inherent in MWD guidance systems. With RMR, "every error is a single-point error. You've still got error, but you're not accumulating it."

Because the sensor is taking readings of the bit's position at regular intervals, any such error is quickly detected, and the driller can correct for it. "It's a shadow. That's all it provides," he notes. "If you've got a wellbore drilled, and you need to parallel it, it takes the instrumentation error out of trying to drill a parallel well."

Hollies points out another trait of the RMR system: the location of the tool's "brains." In competing drilling guidance systems, such as Vector's MGT (magnetic guidance tool), the most expensive hardware is in the well being drilled, with the cheaper equipment sitting in the cased well.

RMR reverses that setup, placing the tool's pricey brains, including the sensor, in the cased hole, free from the heat, vibration and abuse that comes with being attached to a bit drilling a well. Given the cost of the hardware, that setup seems only logical.

"It has inherent safety-liability stuff for the operator," adds Hollies, "by not putting the expensive (hardware) in the open hole."

Vector's Pitzer emphasizes that RMR is not intended to replace MWD, which still guides the drilling process, measuring azimuth and inclination of the assembly. In effect, he says, by using RMR, "you are refining the target, because if you drill out 1 000 metres simply with surveying, using your MWD, you're going to have the inherent error of that system that's going to be five to 10 metres out.

"That's too much. You want to hit a target that is one metre." RMR does that by eliminating the survey error inherent in conventional borehole surveying tools.

According to Pitzer, a fast-emerging application for RMR in the United States is coalbed methane. In particular, it has been used in conjunction with a unique drilling system that uses several horizontal coalbed methane wells to intersect a single vertical well.

"The trick" in such an application, says Pitzer, "is to hit the vertical well with the horizontal one." That is achieved by hanging the RMR sensor in a cavity cut into the wall of the vertical well. The sensor monitors the magnetic field in the immediate area while the horizontal well is drilling toward the vertical one.

"We can see the bit coming from about 50 to 60 metres away," Pitzer explains, "and (we) start giving the directional driller instructions, as well as the coordinates he needs to successfully make contact with the vertical hole."

A company that has made strides in this area is CDX Gas, LLC of Dallas, Texas. Specializing in coalbed methane, CDX has operations in Colorado, West Virginia, and Arkansas, among other coal-bearing states, although for patent reasons, the company is reluctant to discuss the specifics of its drilling techniques, beyond confirming that it uses the RMR guidance system. NTM

— James Mahony

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